REPORT No. 389

THE EFFECT OF SMALL ANGLES OF YAW AND PITCH ON THE CHARACTERISTICS OF AIRPLANE PROPELLERS

BY HUGH B. FREEMAN

SUMMARY

The subject tests were carried out in the 20-foot wind tunnel of the National Advisory Committee for Aeronautics to determine the effect on the characteristics of a propeller of inclining the propeller axis at small angles to the relative wind. Tests were made of a full-scale propeller and fuselage combination at four angles of yaw $(0^{\circ}, +5^{\circ}, +10^{\circ}, and +15^{\circ})$, and of a model propeller, nacelle, and wing combination at five angles of pitch $(-5^{\circ}, 0^{\circ}, +5^{\circ}, +10^{\circ}, and +15^{\circ})$.

The results of the full-scale tests of a propeller and fuselage, without a wing, show that the effect on the propeller performance is small. Similar results are shown by the model test data except that where the propeller is directly in front of the wing there is an appreciable decrease in effective thrust and propulsive efficiency with increase of angle of pitch.

INTRODUCTION

In the prediction of airplane performance it is usual to assume that the line of thrust of the propeller is parallel to the flight path. This condition exists, of course, for only one particular angle of attack of the airplane. For any other angle of attack, especially when climbing or flying horizontally at low speeds, the thrust line is inclined at an angle to the line of flight. Previous model propeller tests have shown that the reduction in thrust is negligible for small angles of pitch. (Reference 1.) Such tests have been made, however, with the propeller alone; so the conditions do not correspond to those found in practice, where the propeller usually operates in front of a body such as a fuselage, nacelle, or wing.

The object of the tests described in this report was to determine the effect of inclining the thrust line at small angles to the relative wind on the characteristics of a propeller operating in front of a body. Two series of tests were made. The first series consisted of yaw tests of a full-scale propeller and fuselage. It would have been desirable to change the angle of pitch instead of that of yaw, but this was not possible with the torque dynamometer available, since it would not function properly except when in a level position. However, for the propeller and fuselage, without a wing, it is

obvious that changing the angle of yaw will cause a similar effect on the propeller performance to that caused by changing the angle of pitch. In the second series, a model propeller and nacelle were tested alone and in two positions relative to a wing, the combination being pitched at various angles. All the tests were made in the 20-foot tunnel of the National Advisory Committee for Aeronautics.

APPARATUS AND TESTS

The full-scale propeller and fuselage are shown mounted in the wind tunnel in Figure 1. The propeller was 9 feet in diameter and had two adjustable aluminum alloy blades. The curves for the blade form and pitch distribution are given in Figure 2. The propeller was driven by a 435-horsepower Curtiss D-12 engine mounted in an open-cockpit fuselage. A dynamometer for measuring the torque of the engine was also mounted in the fuselage. A description of this dynamometer, the thrust balance, and other wind-tunnel apparatus will be found in reference 3.

Tests were made at propeller pitch settings of 15.5° and 23.5° (at 0.75 radius) with the propeller axis yawed at 0°, 5°, 10°, and 15°. The method of conducting the tests was the same as that described in reference 2.

The method of supporting the model wing and nacelle in the wind tunnel is shown in Figure 3. The wing and nacelle pivoted about the top of the two wing supports, and the angle of pitch was changed by raising or lowering the end of the long sting extending in the rear of the wing. A 25-horsepower electric motor, for driving a 4-foot model propeller, was mounted in the nacelle. No means were available by which the torque of the motor could be measured directly; the motor torque was therefore calibrated, for a constant field excitation, using a Prony brake. Later the calibration was checked by means of a dynamometer. The wing was 15 feet 10 inches in span, 3 feet 2 inches in chord, and had a Clark Y airfoil section.

The 4-foot metal propeller used in the model tests was geometrically similar to the propeller used in the full-scale tests. It was first tested with the nacelle alone (fig. 4a), second with the nacelle above the



FIGURE 1.—Full-scale propeller and fuselage

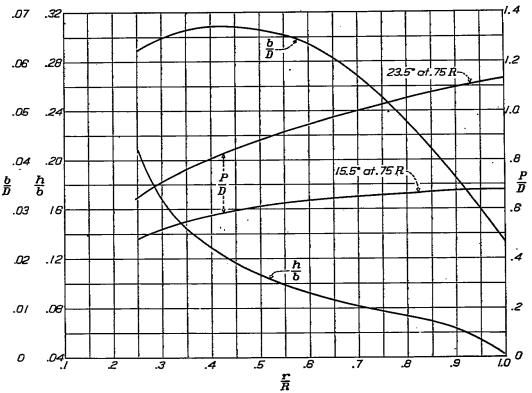


FIGURE 2.—Blade form curves. Propeller No. 4412. b=blade width; D=diameter of propeller; P=pltch; k=maximum blade thickness; R=radius of propeller; r=section radius

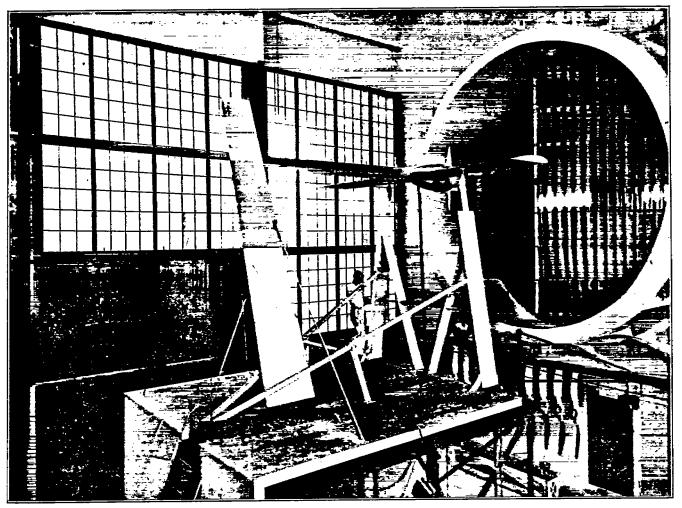
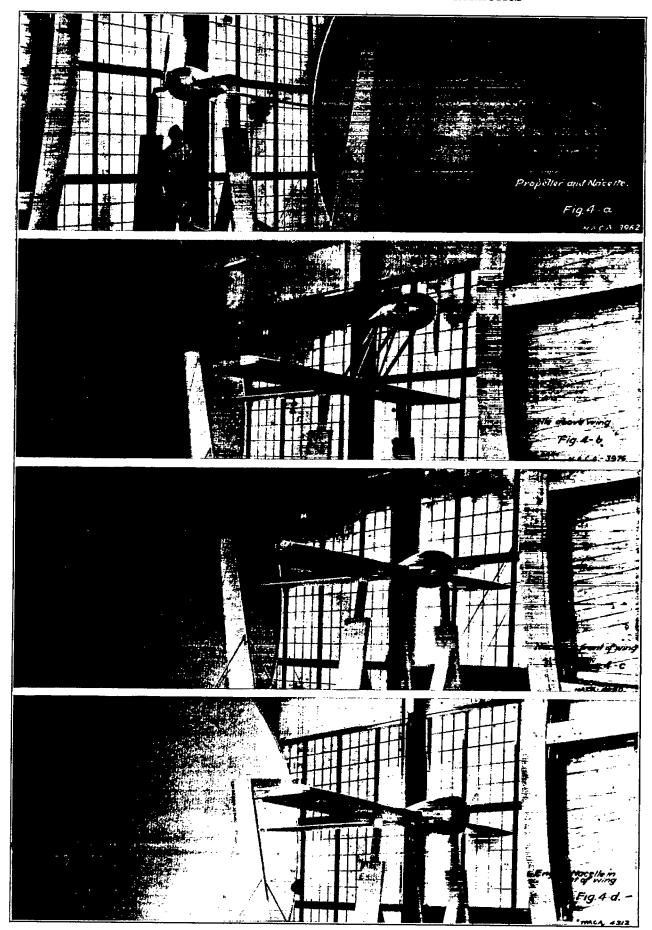


FIGURE 3.-Model engine, nacelle, and wing



wing (fig. 4b), and third in front of the wing (fig. 4c). Later dummy cylinders were fixed to the nacelle to simulate a Wright J-5 engine. The model engine was

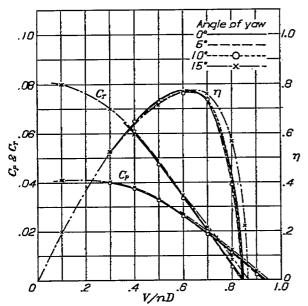


FIGURE 5.—Characteristics of propeller No. 4412, 15.5° at 0.75 R.; diam. 9 ft.

provided with an N. A. C. A. cowling. This arrangement (fig. 4d) was tested in the same position relative to the wing as that shown in Figure 4c. All the arrangements were tested at four propeller blade settings (12°, 17°, 22°, and 27° at 0.75 radius) and with the thrust line at five angles of pitch (-5°, 0°,

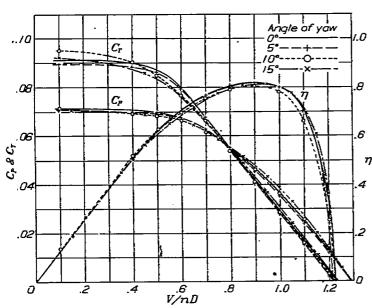


FIGURE 6.—Characteristics of propeller No. 4412, 23.5° at 0.75 R; diam. 9 ft.

+5°, +10°, and +15°) relative to the wind direction. The forces in the model tests were measured in the same manner as those in the full-scale tests, except that the torque of the motor was obtained from the calibration curve (armature current versus torque) previously determined.

For zero pitch or yaw, the resultant horizontal force on the propeller-body combination, as measured on the thrust balance, is equal to:

$$R = T - \Delta D - D$$

where T=propeller thrust (tension in propeller shaft), D=drag of combination without propeller (at the same dynamic pressure q),

 ΔD = increment of drag due to slipstream.

The effective thrust may be defined as

$$T - \Delta D = R + D$$

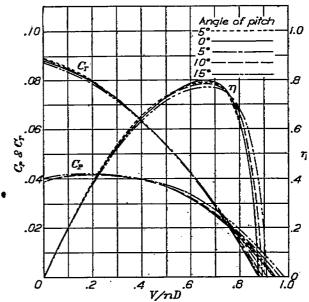


FIGURE 7.—Characteristics of propeller No. 4412; 4 ft. diam.; set 17° at 0.75 R; nacelle alone

RESULTS AND DISCUSSION

The data are reduced to the usual nondimensional coefficients of thrust, power, and propulsive efficiency:

Thrust coefficient = $C_T = \frac{\text{effective thrust}}{\rho \ n^2 \ \overline{D^4}}$

Power coefficient $=C_P = \frac{\text{input power}}{\rho n^3 D^3}$

effective thrust × velocPropulsive efficiency = ity of advance
input power

where $\rho = \text{mass density of the air,}$ n = revolutions per unit time,D = diameter of propeller.

The observed data are given in Tables I and II for the full-scale tests.

The faired curves of these coefficients plotted against $\frac{V}{nD}$ are given in Figures 5 and 6. These

curves show no consistent variation with the change in the angle of yaw. The change in the thrust and power coefficients is small and the greatest variation in the peak efficiency is only 2 per cent.

The results for the model propeller tests are given in Figures 7 to 10, inclusive. Only the curves for the 17° blade settings are presented, since these are repre-

sentative of the curves for all the blade settings. The tables of these data have not been included in this report, since they are soon to be published in a report on wing-nacelle-propeller tests.

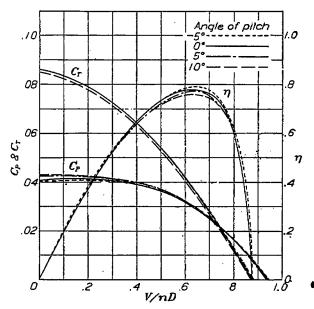


FIGURE 8.—Characteristics of propeller No. 4412; 4 ft. diam.; set 17° at $0.75~R_{\rm f}$ nacelle above wing

For the propeller with the nacelle alone (fig. 7) there is very little change in the characteristics of the propeller for the change in the angle of the thrust line. When the propeller and nacelle are placed above the

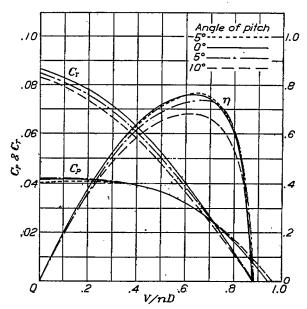


FIGURE 9.—Characteristics of propeller No. 4412; 4 ft. diam.; set 17° at 0.75 R; nacelle in front of wing

wing (fig. 8) there is a small but consistent decrease in effective thrust with increasing angle of pitch. Figures 9 and 10 show the results for the propeller and nacelle directly in front of the wing. For this condition the effective thrust decreases rapidly with increasing angle of the thrust line. For the model

engine nacelle with the propeller set at 17° (fig. 10) the decrease in effective thrust at the $\frac{V}{nD}$ of peak effi-

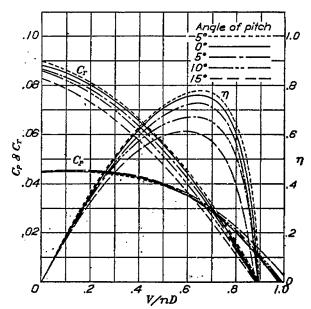


FIGURE 10.—Characteristics of propeller No. 4412; 4 ft. diam.; set 17° at 0.76 R; model engine nacelle in front of wing

ciency for a change in the angle of thrust line of 15° amounts to approximately 19 per cent.

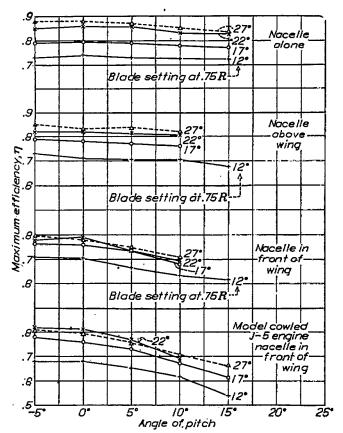


FIGURE 11.—Peak efficiencies against angles of pitch

In Figure 11 the peak efficiency, for the various blade settings and wing-nacelle combinations, has been

plotted against the angle of pitch. For the nacelle alone, the greatest change in peak efficiency for a 15° change in the angle of thrust line is 5 per cent. With the model cowled-engine nacelle, in front of the wing the greatest decrease in efficiency amounts to 15 per cent. The drop in peak efficiency is greater for the high blade settings than for the low, but the difference is small.

The results of the above tests indicate that the effect of small angles of yaw and pitch on the characteristics of a propeller is small provided there is no wing in the slipstream. However, if the propeller is working directly in front of a wing, the effective thrust and propulsive efficiency decrease rapidly with increasing angle of pitch.

Langley Memorial Aeronautical Laboratory, National Advisory Committee for Aeronautics, Langley Field, Va., January 20, 1931.

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TABLE I TEST RESULTS

PROPELLER 4412-23.5° AT 0.75R. 0° YAW

| | | | | | | .020. 0 1 | | | |
|----------|------------------|------------------|------------------|------------|----------------|------------------|----------------|----------------|-----|
| ١. | 17 | N | 0 | T | _ | | V | 1 | ī |
| P | m. p. h. | r. p. m. | lb it. | lb. | C _₹ | C_P | $\frac{1}{nD}$ | 7 7 | |
| | _! | | <u> </u> | <u> </u> | l | 1 | "" | Ţ | - 1 |
| 0.002331 | | | | 1 | | | | <u> </u> | ⊣ |
| . 002331 | 87.0 87.0 | 1,580 | 1,058 | 906 | 0.0854 | 0.0696 | 0. 538 | 0.659 | - 1 |
| .002327 | | 1,580 | 1,056 | 904 | . 0350 | . 0896 | . 538 | . 656 | - 1 |
| . 002327 | | 1,590 | 1,059 | 878 | . 0815 | . 0687 | . 535 | . 635 | -1 |
| 002327 | | 1,590 1,590 | 1,056 | 884 | . 0825 | . 0687 | . 566 | .630 | J |
| .002327 | 94.7 | 1,590 | 1,060 1,058 | 878 | . 0820 | . 0690 | . 588 | . 692 | - 1 |
| .002313 | | 1,600 | 1.080 | 877 | . 0820 | . 0687 | . 583 | . 695 | - 1 |
| . 002313 | 105.0 | 1,620 | 1,057 | 845 840 | .0782 | . 0685 | .640 | .731 | - 1 |
| 002813 | 103.9 | 1,550 | 950 | 758 | | . 0667 | .634 | . 722 | Ţ |
| 002313 | 103.9 | 1,550 | 957 | 759 | . 0749 | . 0662 | 655 | . 740 | - 1 |
| .002318 | 103.5 | 1,480 | 839 | 650 | . 0749 | .0862 | . 655 | 740 | |
| .002313 | 103.5 | 1, 480 | 840 | 649 | .0703 | . 0634 | . 683 | . 757 | |
| .002316 | 103.0 | 1,410 | 727 | 547 | .0651 | .0606 | . 683 | - 757 | 1 |
| . 002316 | 103.0 103.2 | 1,410 | 728 | 545 | .0619 | . 0505 | .714 | -768 | |
| . 002309 | 102.8 | 1,310 | 643 | 465 | 0616 | . 0503 | 750 | . 769 . 780 | 1 |
| .002309 | 102.9 | 1,350 | 642 | 464 | 0508 | .0584 | .746 | 775 | Т |
| .002309 | 102.8 | 1,280 | 552 | 390 | . 0567 | .0557 | .786 | :800 | 1 |
| . 002309 | | 1, 270 | 551 | 389 | .0574 | 0559 | 791 | 799 | 1 |
| . 002309 | | 1, 230 | 478 | 326 | .0512 | . 0524 | .817 | .800 | ļ |
| . 002309 | | 1, 220 I, 170 | 477 | 324 | .0519 | . 0532 | 823 | .801 | Т |
| .002309 | 102.0 | I, 170 | 413 | 272 | .0173 | .0501 | . 853 | . 805 | Т |
| . 002309 | 102.2 | I, 170 1, 110 | 412 | 271 | . 0172 | .0501 | .855 | 805 | 1 |
| . 002309 | 101.6 | 1, 110 | 343 | 217 | .0419 | .0461 | .895 | .812 | 1 |
| . 002309 | 101.8 | 1, 100 | 342 | 215 | . 0423 | .0168 | . 905 | 817 | 1 |
| 002309 | 101.8 | 1,050 | 278 | 165 | . 0356 | .0118 | . 947 | 806 | ŀ |
| .002309 | 101.6 | 1,050 | 278 | 165 | . 0358 | .0118 | 956 | .820 | ı |
| . 002309 | 101.6 | 1,000 | 235 | 133 | 0316 | .0390 | .991 | . 803 | |
| .002309 | 10L 6 | 1,010 | 235 | | . 0308 | . 0382 | .984 | .794 | 1 |
| .002309 | 101. 4 101. 2 | 950 | 169 | 86 | 0227 | . 0311 | L 044 | .761 | 1 |
| .002309 | 101.2 | 900 | 126 | 57 | .0167 | . 0258 | 1, 10 | .712 | |
| 002301 | 101.0 | 860 800 | 77 | 25 | - 00805 | .01722 | 1.15 | . 537 | |
| .002301 | 101.0 | 780 | 40 | 1 | .000372 | . 0101 | 1. 233 | .0142 | Į |
| 002313 | 78.5 | 1, 585 | 1 050 | -29 926 | 01135 | 0 | 1. 267 | | -1 |
| .002313 | 78.9 | 1, 580 | 1, 058 1, 051 | 920 | 0878 | . 0700 | 485 | . 608 | [|
| .002313 | 74.8 | 1, 580 | 1,056 | 930 | .0878 .0885 | . 0698 | . 489 | . 615 | 1 |
| .002313 | 71.1 | 1,580 | 1,058 | 930 | . 0350 | .0702 | . 460 | . 580 | 1 |
| .002316 | 67.3 | 1,580 | 1,056 | 930 | .0885 | . 0700 . 0702 | . 441 | . 557 | 1 |
| . 002316 | 67.0 | 1, 580 | 1,056 | 936 937 | .0891 | .0702 | 417 | . 529 | Ł |
| . 002316 | 62.8 | 1, 580 | 1,062 | 939 | 0394 | .0702 | . 415 . 389 | . 526 | 1 |
| .002316 | 63.0 | 1, 580 | 1,080 | 940 | .0895 | .0704 | . 389 | .498 | 1 |
| .002319 | 57.4 | 1, 590 | 1,085 | 948 | .0389 | .0695 | . 353 | . 45I | 1 |
| . 002319 | 56.4 | 1, 590 | 1. OA1 | 946 | .0387 | .0693 | . 347 | . 445 | ŀ |
| .002325 | 23.3 | 1,580 | 1,068 | 950 | .0396 | .0705 | . 1445 | .1838 | 1 |
| . 002325 | 24.2 | 1, 530 | 1,056 | 945 | 0953 | .0744 | . 1545 | .198 | I |
| | L | | _ 1 | .] | | 1 | | .100 | 1 |

TABLE I—Continued
TEST RESULTS

PROPELLER 4412-23.5° AT 0.75R. 5° YAW

| | | - FR | OLEPP | EK 44 | 12-23.5 | AT 0.7 | 5R. 5° Y. | ΑW | | |
|-----|----------------------|--|--------------------------------------|--|--|--|--|-------------------------|----------------|---|
| | ρ | W m, p, h, | <i>N</i> r. p. m. | Ib. ft. | lb. | CT | CP | $\frac{V}{nD}$ | P | 7 |
| | 0.002275 | 85.8 | 1, 600 | 1,036 | 899 898 882 882 860 | 0.0846 | 0.0681 | 0, 525 | 0, 652 | Ī |
| - 1 | . 002275 | 85.8 | 1.600 | 1,038 | 898 | . 0845 | .0681 | . 525 | .652 | |
| - 1 | . 002275 | 90.6 | 1,600 1,600 | 1.042 | 882 | .0830 | .0683 | .554 | - 673 | |
| - 1 | . 002275 | 90.5 | 1,600 | 1,040 | 882 | .0830 | .0683 | 553 | 672 | 1 |
| ſ | . 002265 | 95.5 | L 610 | 1.041 | 880 | .0830 | .0879 | .580 | 687 | 1 |
| | . 002265 | 95. 6 | 1,600 | 1.040 | 861 825 | .0815 .0754 | . 0687 | 885 | . 694 | 1 |
| - 1 | . 002259 | 106.5 | 1,630 | 1,040 | 825 | . 0754 | . 0687 . 0664 | . 585 . 640 | .724 | 1 |
| - 1 | . 002259 | 106.0 | 1,630 1,640 | 1,040 1,037 | 821 757 757 687 | 1 0743 | . 0355 . 0652 | .632 | .717 | 1 |
| J | . 002259 | 106.2 | 1 1 890 | 960 959 877 | 757 | .0735 .0735 .0717 .0715 | .0652 | . 657 | .741 | 1 |
| - } | . 002259 | 106.0 105.8 | 1,580 | 959 | 757 | . 0735 | 1 .0650 | . 657 | .744 | 1 |
| ٧. | . 002250 | 105.8 | 1,630 | 877 | 687 | . 0717 | .0639 .0639 .0618 | . 676 | 759 | 1 |
| - 1 | . 002250 | 105. 8 105. 0 | 1, 580 | 878 | 685 | . 0715 | .0639 | 1 .676 | . 757 | Ī |
| | . 002250 | 105.0 | 1,480 | 796 | 606 | 1 . 01576 | 0818 | .694 | .758 | 1 |
| - ! | . 002250 | 100.1 | 1,470 | 791 | 607 | .0688 | 0621 | . 694 . 700 | .772 | 1 |
| ſ | . 002250 | 101.9 104.9 | 1, 410 | 685 | 508 | 1 . UB28 | . 0886 | . 726 | . 773 | 1 |
| - 1 | . 002200 | 101.9 | 1, 100 | 878 796 791 685 683 611 | 508 438 | . 0633 0596 | . 0593 . 0580 | . 732 | . 781 | 1 |
| -1 | .002250 | 101.5 | 1, 410 1, 400 1, 340 1, 310 | 011 | 438 | . 0596 | .0580 | . 726 . 732 . 765 | . 786 | 1 |
| - 1 | . 002250 | 101.2 | 1,010 | 011 | 437 | . 0593 | . 0580 | . 763 | 780 | 1 |
| - 1 | . 002250 | 101.0 | 1,270 | 010 | 354 | .0537 | . 0538 | . 763 . 802 | .800 | 1 |
| - 1 | .002254 | 1010 | 1, 270 1, 260 1, 220 1, 220 | 611 510 508 438 439 378 | 353 | . 0543 | . 0544 | .807 .833 .831 | .806 | |
| | . 002251 | 1 102 6 | 1 220 | 400 | 297 295 | .0185 | 0500 | 833 | .807 | |
| | . 002254 | 103.8 103.8 | 1, 160 | 708 | 0.49 | .0182 | .0501 | . 831 | .800 | ı |
| - [| . 002254 | 103.0 | 1, 170 | 360 | 240 | .0140 | .0178 .0175 | 1 .875 | .808 | ı |
| -1 | . 002246 | 103. 2 103. 4 | 1, 170 1, 100 | 911 | 194 | .0142 .0391 | .0175 | . 863 | . 802 | 1 |
| 1 | 002246 | 103.4 | 1, 100 1, 040 1, 040 970 | 382 311 311 248 | 194 | 0391 | .0139 | . 920 | . 820 | ł |
| - 1 | .002246 | 103. 4 103. 4 | 1,000 | 948 | 148 | .0331 | .0139 | . 920 | . 820 | |
| 1 | . 002246 | 103. 0 103. 2 103. 2 103. 2 103. 0 | 1 040 | 248 | 144 | .0325 | 0392 0388 | .972 | . 829 . 810 | ı |
| | . 002246 | 103.2 | 2,010 | 246 166 | 86 | . 0223 | . 0388 | . 968 | . 810 | 1 |
| 1 | . 002246 | 103.2 | 930 | 131 | 63 | .01775 | . 0301 | L 04 | . 770 | ı |
| 1 | . 002246 | 103.2 | 880 | 91 | 35 | .01101 | .0258 | 1.083 1.146 | . 746 | 1 |
| | . 002246 | 103.0 | 880 820 | 31 | -4 | 00145 | 00700 | 1. 23 | . 633 | 1 |
| | . 002256 . 002256 | | 1, 590 | 1.033 | ดกล้ | 0973 | . 00786 . 0694 . 0682 . 0686 | .494 | . 621 | 1 |
| Ţ | . 002256 | 79. 8 74. 8 74. 8 | 1,590 1,600 | 1, 033 1, 031 | 919 909 | . 0373 . 0365 | 0682 | 488 | .619 | l |
| 1 | . 002256 | 74.8 | 1,600 1,590 | 1. 037 | 919 | . 0872 | 0002 | .457 | . 580 | ļ |
| | . 002256 | 74.8 | 1,590 | 1,037 1,036 | 918 | 0883 | 0805 | 460 | .584 | |
| | . 002259 | 69.4 | 1,600 | 1.010 | 922 | . 0875 | 0.0007 | 424 | .540 | |
| ı | . 002259 | 69. 4 | 1,600 1,600 | 1,037 | 922 | . 0875 | 0885 | . 424 | .541 | |
| 1 | .002262 | 65.2 | 1.610 | 1,010 1,037 1,011 | 919 918 922 922 927 925 929 928 931 932 906 900 | . 0872 . 0883 . 0875 . 0875 . 0890 . 0882 . 0881 . 0894 . 0895 | . 0886 . 0895 . 0587 . 0585 . 0707 . 0687 . 0889 . 0889 . 0698 . 0698 . 0703 | .398 | .487 | 1 |
| 1 | .002262 | 68. 5 59. 0 | 1,600 1,600 | 1,040 1,045 | 925 | . 0330 | .0687 | . 338 | 497 | |
| 1 | . 002262 | 59.0 | 1,600 [| 1,045 | 929 | 0382 | .0389 | 361 | 462 | |
| 1 | .002262 | 59.3 | 1,600 1,590 | 1,014 | 928 | .0881 | .0880 | .361 .362 | . 463 | |
| 1 | .002262 | 56.1 56.1 | 1,590 | 1,046 | 931 | . 0394 | 0898 | . 348 | . 443 | H |
| 1 | .002262 | 56.1 | 1,590 | 1,044 1,046 1,045 1,051 | 932 | . 0895 | 0698 | . 346 | . 444 | |
| | .002267 | 23.8 | 1,590 1,550 | 1, 051 | 906 | . 0366 | 0703 | . 1465 | . 181 | H |
| 1 | . 002287 | 24.4 | 1, 550 | 1,045 | 900 | . 0908 | .0734 | .154 | . 191 | 1 |

TABLE I—Continued TEST RESULTS

PROPELLER 4412-23.5° AT 0.75R. 10° YAW

| | | | | | A1 0.70 | T. W. I. | Δ. γγ | | |
|---|--|--|---|--|---|--|--|---|---|
| ρ | m. p. | h. r.p.m. | Q lb. ft. | T lb. | Ст | CP | T' nD | | _ |
| 0. 0022 | m. p. 233 83.8 330 88.4 330 88.4 330 88.4 330 98.0 330 94.0 330 94.0 330 94.0 331 7 102.8 31 102.0 31 102.0 31 102.0 31 102.7 3 | h. r. p. m. 1,590 1,590 1,600 1,590 1,600 1,590 1,600 1,590 1,610 1,570 1,520 1,510 1,410 1,410 1,410 1,410 1,110 1,110 1,110 1,110 1,110 1,1070 1,07 | Ib. ft. 1, 012 1, 010 1, 012 1, 013 1, 011 1, 002 923 855 772 923 855 778 708 632 632 635 632 634 539 436 436 389 320 245 247 108 83 436 | 1b. 8773 878 8555 8555 8555 850 850 850 850 850 850 | 0. 0848 0.8348 0.8315 0.835 0.9303 0.746 0.7046 0.7046 0.7047 0.7015 | 0. 0055 0085 0085 0078 0085 0078 0085 0073 0059 0073 0016 0013 0012 0001 0599 0556 0536 0536 0536 0516 0616 0616 0617 0497 | | 0. 638 .638 .638 .650 .671 .674 .683 .710 .736 .747 .750 .747 .765 .765 .7785 .785 .785 .785 .785 .785 .785 .7 | |
| . 00222 . 00222 . 00222 . 00222 . 00222 . 00222 . 00222 . 00222 . 00222 . 00222 | 78. 8 73. 0 78. 0 78. 0 67. 6 88 66. 7 88 61. 9 88 57. 9 8 57. 9 8 21. 75 | 1, 600 1, 600 1, 590 1, 590 1, 600 1, 610 1, 610 1, 600 1, 600 1, 605 1, 580 1, 540 | 1,004 1,005 1,013 1,019 1,018 1,019 1,017 1,021 1,023 1,024 1,017 | 886 870 909 905 927 927 951 948 961 957 944 933 | . 0856 . 0841 . 0889 . 0885 . 0892 . 0892 . 0905 . 0903 . 0925 . 0917 . 0930 . 0970 | . 0677 . 0677 . 0689 . 0087 . 0684 . 0682 . 0675 . 0676 . 0684 . 0705 . 0736 | . 485 . 482 . 450 . 450 . 413 . 408 . 382 . 876 . 354 . 353 . 1347 . 1412 | . 613 . 599 . 660 . 580 . 539 . 534 . 512 . 503 . 477 . 473 . 1777 . 1880 | |

TABLE I—Continued TEST RESULTS

PROPELLER 4412-23.5° AT 0.75R. 15° YAW

| No. No. No. Po. | | | ROPEL | LLER 2 | 412-23. | 5° AT 0.7 | 5 <i>R</i> . 15° Y | AW | |
|--|----------|--------|---------|--------|---------|----------------|--------------------|--------|-------|
| 002223 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 | ρ | | | lb. ft | | C _T | C _F | | |
| 002226 | | 85.2 | 1,590 | 998 | 1, 364 | | | | |
| 002223 38.5 1,600 997 1,838 0807 0678 544 649 | | | 1 2 200 | 1 000 | 1,380 | | 0676 | | |
| 002223 93.8 1,600 998 1,205 0784 0770 0774 0576 078223 93.0 1,600 998 1,205 0784 0668 568 667 002223 95.5 1,590 996 1,281 0780 0670 0583 677 002223 103.0 1,620 997 1,219 07745 0674 0625 0627 06223 102.2 1,540 894 1,137 0716 0682 0550 0718 002213 102.2 1,540 894 1,137 0716 0682 0500 0718 002213 102.2 1,490 801 1,057 0684 0634 0670 0718 002213 102.2 1,490 801 1,057 0684 0634 070 0718 002213 102.2 1,490 801 1,057 0684 0634 070 0718 002213 102.2 1,490 801 1,057 0684 0634 070 | | | 1,000 | 4,000 | | . 0807 | 1800 | | |
| 002223 93. 0 1,600 938 1,306 0.0784 0.068 568 5687 | | | | | 1, 538 | | | | . 647 |
| Occasia Occa | | | 1 800 | | | .0780 | .0670 | | . 668 |
| 002223 06.5 1,500 996 1,285 07780 0679 585 677 | | OK S | 1 600 | | 1,000 | | | | . 667 |
| 002213 102 2 1, 500 997 1, 218 0728 0658 652 659 | | OX K | | | 1, 200 | | | 583 | |
| 0.02213 102.2 1,540 897 1,219 0.0745 0.0652 0.050 0.02213 102.2 1,540 884 1,137 0.0716 0.0652 0.050 715 0.02213 102.2 1,490 801 1,057 0.084 0.034 0.070 0.02213 102.2 1,490 801 1,057 0.084 0.034 0.070 0.02213 102.2 1,490 801 1,057 0.084 0.034 0.070 0.02213 101.5 1,410 701 974 0.047 0.0610 705 748 0.02213 101.5 1,410 701 974 0.047 0.0610 704 748 0.02213 101.3 1,340 606 890 0.0599 0.0583 740 704 0.02213 101.3 1,335 605 891 6003 0.0583 740 704 706 0.02213 101.3 1,200 551 830 0.0505 0.0560 7742 763 0.02213 101.3 1,270 530 828 0.0570 0.0568 775 782 0.02213 101.1 1,215 457 771 0.028 0.0555 815 801 0.02213 101.1 1,215 457 771 0.028 0.0555 815 801 0.02213 101.1 1,160 395 718 0.479 0.0508 8.53 8.04 0.02213 101.1 1,160 395 718 0.479 0.0508 8.53 8.04 0.02215 101.1 1,160 395 716 0.047 0.0508 8.53 8.04 0.02205 101.0 1,100 341 0.74 0.0441 0.0406 899 8.10 0.02205 100.8 1,030 239 504 0.0339 0.0458 730 8.00 0.02205 100.0 1,100 341 0.74 0.0441 0.0406 899 8.10 0.02205 100.0 1,100 341 0.74 0.0441 0.0406 899 8.10 0.02205 100.0 1,000 239 504 0.0339 0.0458 730 8.30 0.02205 100.0 1,000 241 600 0.0342 0.0411 0.78 8.12 0.02205 100.0 4 860 80 409 0.02205 100.0 4 860 80 409 0.02205 100.0 4 860 80 409 0.02205 100.0 4 860 80 409 0.02205 100.0 4 860 80 409 0.02205 100.0 4 860 80 409 0.02205 100.0 4 860 80 409 0.02205 100.0 4 860 80 409 0.02205 100.0 4 860 80 409 0.02205 100.0 4 860 80 409 0.02205 100.0 4 860 80 409 0.02205 100.0 4 860 80 409 0.02205 100.0 4 860 80 409 0.02205 100.0 4 860 80 400 | | 103.0 | 1 620 | 007 | 1 201 | | .0879 | . 587 | |
| 002213 102.2 1,540 884 1,137 0715 0862 080 713 002213 102.2 1,540 881 1,141 0719 0862 650 716 002213 102.2 1,470 800 1,057 0884 0843 670 730 002213 102.2 1,470 800 1,057 0884 0843 670 730 002213 101.5 1,410 701 974 0847 0610 705 748 002213 101.5 1,410 701 974 0847 0610 704 748 002213 101.5 1,410 701 976 0852 0853 737 748 002213 101.3 1,40 701 976 0859 0558 740 761 002213 101.3 1,20 851 850 0585 740 761 002213 101.3 1,20 851 850 0585 740 761 002213 101.3 1,270 850 882 0585 0560 775 782 002213 101.3 1,270 850 882 0585 0560 775 782 002213 101.1 1,215 457 771 0526 0565 780 0568 780 002213 101.1 1,215 457 771 0526 0555 815 801 002213 101.1 1,20 851 850 0565 718 0479 0568 780 002213 101.1 1,20 851 850 0565 718 0479 0568 780 002213 101.1 1,160 395 718 0479 0568 853 804 002205 101.0 1,100 341 674 0441 0496 899 810 002205 100.8 1,050 293 640 0336 0449 932 800 002205 100.8 1,050 293 654 0336 0449 932 801 002205 100.7 1,050 293 654 0336 0449 932 801 002205 100.7 1,050 293 654 0336 0449 932 801 002205 100.8 1,050 293 654 0336 0449 932 801 002205 100.8 1,050 293 654 0336 0449 932 801 002205 100.7 1,050 293 654 0336 0449 932 801 002205 100.7 1,050 293 654 0336 0449 932 801 002205 100.8 1,050 293 654 0336 0449 932 801 002205 100.8 1,050 293 654 0336 0449 932 801 002205 100.7 1,050 239 650 0335 0411 975 120 002205 100.7 1,050 239 650 0335 0411 975 120 002205 100.7 1,050 239 650 0335 0411 975 120 002205 100.7 1,050 239 650 0335 0411 975 120 002205 100.7 1,050 239 650 0335 0411 975 120 002205 100.7 1,050 239 650 0335 0411 975 120 002205 100.7 1,050 239 650 0335 0411 975 120 002205 100.7 1,050 239 650 0335 0411 975 120 002205 100.7 1,050 239 650 0335 0411 975 120 002205 100.7 1,050 239 650 0335 0411 975 120 002205 100.7 1,050 239 650 0335 0411 975 120 002205 100.7 1,050 239 650 0335 0411 975 120 002205 100.7 1,050 239 650 0335 0411 975 120 002205 100.7 1,050 239 650 0335 0411 975 120 002205 100.7 1,050 239 650 0335 0411 975 120 002205 100.7 1,050 239 650 0335 0411 975 145 145 145 145 145 145 145 145 145 14 | | 102.8 | 1 800 | 007 | 1 210 | | | . 522 | . 689 |
| 002213 102.2 1,450 808 1,141 .0719 0652 650 715 002213 102.2 1,490 801 1,057 0684 .0640 650 .730 002213 101.5 1,410 701 974 0647 .0610 705 748 002213 101.3 1,410 701 974 0647 .0610 705 748 002213 101.3 1,410 701 974 0647 .0610 705 748 002213 101.3 1,40 606 890 .0599 .0583 740 746 002213 101.3 1,235 605 891 .0603 .0583 742 761 002213 101.3 1,235 605 891 .0603 .0586 742 763 002213 101.3 1,20 851 830 .0505 .0560 775 782 002213 101.1 1,216 457 771 .0528 .0535 811 .002213 101.1 1,220 450 772 .0522 .0535 811 .704 002213 101.1 1,160 395 718 .0479 .0508 .833 .804 002213 101.1 1,160 395 718 .0479 .0508 .833 .801 002205 101.0 1,100 341 674 .0441 .0496 .890 .808 002205 101.0 1,100 341 674 .0441 .0496 .890 .808 002205 100.7 1,090 .290 .634 .0385 .0410 .892 .808 002205 100.7 1,090 .290 .634 .0385 .0410 .932 .801 002205 100.7 1,090 .290 .634 .0385 .0410 .932 .801 002205 100.8 1,050 .239 .506 .0335 .0411 .975 .812 002221 76.5 1,580 .998 1,424 .0899 .0983 .445 .562 002221 76.5 1,580 .998 1,424 .0899 .0983 .445 .562 002222 66.3 1,580 .998 1,424 .0899 .0883 .445 .562 002224 67.0 1,595 1,005 1,447 .0881 .0881 .0883 .445 .562 002225 517.7 1,595 1,000 1,487 .0881 .0881 .0833 .445 .562 002225 57.7 1,600 1,001 1,007 1,487 .0881 .0881 .0833 .445 .562 002225 57.7 1,600 1,007 1,487 .0881 .0881 .0833 .445 .562 002225 57.7 1,600 1,007 1,487 .0885 .0676 .383 .494 .002225 .577 1,600 1,007 1,487 .0885 .0676 .383 .445 .560 .002225 .577 1,600 1,007 1,487 .0885 .0676 .383 .445 .002225 .577 1,600 1,007 1,457 .0885 .0676 .383 .445 .560 .002225 .577 1,600 1,007 1,457 .0885 .0676 .383 .445 .560 .002225 .577 1,600 1,007 1,457 .0885 .0676 .383 .494 .002225 .577 1,600 1,007 1,457 .0885 .0676 .383 .494 .002225 .577 1,600 1,007 1,457 .0885 .0676 .383 .494 .002225 .577 1,600 1,007 1,457 .0885 .0676 .383 .494 .002225 .577 1,600 1,007 1,457 .0885 .002225 .577 1,600 1,007 1,457 .0885 .002225 .577 1,600 1,007 1,457 .0885 .002225 .577 1,600 1,007 1,457 .0885 .002225 .577 1,600 1,007 1,457 .0885 .002225 .577 1,600 1,007 1,457 .0885 .00225 .577 1,600 1,007 1,45 | | 102.2 | | | 1 127 | 0715 | | 024 | . 695 |
| 0.00213 101.2 1,450 801 1,057 0.084 0.0832 0.070 730 | . 002213 | 102.2 | | | 1 7 74 | | | | .718 |
| 002213 101. 5 1,410 701 974 0047 00610 705 748 | . 002213 | | | | 1 057 | | | . 050 | |
| 002213 101.5 1.410 701 974 0047 0010 705 748 | .002213 | 102.2 | | | 1,000 | | 0032 | .070 | . 730 |
| .002213 101.3 1,340 606 890 0399 0583 740 764 002213 101.3 1,340 606 890 0399 0583 740 763 002213 101.3 1,385 605 891 0603 0583 740 763 002213 101.3 1,280 851 830 0565 0560 775 782 002213 101.1 1,215 457 771 0526 0565 780 775 782 002213 101.1 1,215 457 771 0526 0535 815 80 782 002213 101.1 1,215 457 771 0526 0535 815 80 782 002213 101.1 1,215 457 771 0526 0535 815 80 782 002213 101.1 1,200 305 718 0479 0508 883 804 002213 101.1 1,160 305 718 0479 0508 883 804 002213 101.1 1,160 305 716 0476 0508 833 804 002205 101.0 1,100 341 674 0441 0406 809 810 002205 100.8 1,050 203 640 0390 0485 300 808 002205 100.8 1,050 203 640 0390 0485 300 808 002205 100.1 0,100 341 674 0441 0406 809 810 002205 100.8 1,050 203 640 0390 0485 300 808 002205 100.7 1,000 230 606 0335 0411 7978 800 808 002205 100.7 1,000 230 606 0335 0411 7978 800 808 002205 100.7 1,050 230 600 808 035 002205 100.7 1,050 230 600 808 035 002205 100.8 1,050 230 600 808 035 0411 7978 800 808 002205 100.8 1,050 230 600 808 035 0411 7978 800 808 002205 100.8 1,050 230 600 0342 0411 7975 812 002205 100.4 880 900 149 838 0024 0411 7975 812 002205 100.4 880 900 149 838 0024 0411 7975 812 002205 100.4 880 900 149 838 0024 0411 7975 812 002205 100.4 880 90 409 0121 0211 1.140 608 781 002205 100.4 880 900 149 838 0024 0411 7975 812 002205 100.4 880 900 149 838 0024 0411 7975 812 002205 100.4 880 900 149 838 0024 0411 7975 812 002205 100.4 880 90 409 0121 00211 1.140 608 781 002205 100.4 880 900 149 838 0024 0411 7975 812 002205 100.4 880 900 149 838 0024 0411 7975 812 002205 100.4 880 900 149 838 0024 0411 7975 812 002205 100.4 880 900 149 838 0024 0411 7975 812 002205 100.4 880 900 149 838 0024 0411 7975 812 002205 100.4 880 900 149 838 0024 0411 7975 812 002205 100.4 880 900 149 838 0024 0411 7975 812 002205 100.4 880 900 149 838 0024 0411 7975 812 002205 100.4 880 900 149 838 0024 0411 7975 812 002205 100.4 880 900 149 838 0024 0411 7975 812 002205 100.5 810 100 100 100 100 100 100 100 100 100 | | 101.5 | | | | 0647 | 0040 | . 680 | |
| . 002213 101.3 1,380 606 890 .0599 .0583 .740 .761 .002213 101.3 1,385 605 891 .0603 .0586 .742 .763 .002213 101.3 1,280 881 830 .0565 .0560 .775 .782 .002213 101.1 1,216 .477 .71 .0528 .0535 .811 .801 .002213 101.1 1,220 .460 .772 .0523 .0535 .811 .801 .002213 101.1 1,180 .395 .718 .0479 .0538 .833 .804 .002213 101.1 1,180 .395 .718 .0479 .0508 .833 .801 .002213 101.1 1,180 .395 .718 .0479 .0508 .833 .800 .002225 101.0 1,100 .341 .674 .0441 .0496 .399 .810 .002205 101.0 1,100 .341 .674 .0441 .0496 .399 .810 .002205 101.0 1,100 .342 .676 .0437 .0451 .390 .808 .002205 101.0 1,090 .239 .804 .0336 .0416 .395 .800 .002205 100.7 1,090 .239 .806 .0336 .0416 .932 .801 .002205 100.8 1,030 .233 .640 .0399 .0458 .390 .820 .002205 100.8 1,010 .241 .800 .0342 .0416 .935 .706 .002205 .000.8 .800 .800 .002205 .000.8 .800 .800 .002205 .000.8 .800 .800 .800 .002205 .000.8 .800 .800 .800 .002205 .000.8 .800 .800 .800 .002205 .000.8 .800 .800 .800 .002205 .000.8 .0002205 .000.8 .0002205 .000.8 .0002205 .000.8 .0002205 .000.8 .0002205 .000.8 .0002205 .000.8 .0002205 .000.8 .0002205 .000.8 .0002205 .000.8 .0002205 .000.8 .0002205 .000.8 .0002205 .000.8 .0002205 .000.8 .0002205 .000.8 .800 .800 .0002205 .000.8 .800 .800 .800 .0002205 .000.8 .800 .800 .800 .0002205 .000.8 .800 .800 .800 .0002205 .000.8 .0002205 .000.8 .0002205 .000.8 .0002205 .000.8 .0002205 .000.8 .0002205 .000.8 .0002205 .000.8 .0002205 | . 002213 | 101.3 | | | | 0647 | 0010 | | |
| . 002213 101. 3 1, 385 605 891 .0603 .0586 .742 .763 .002213 101. 3 1, 280 581 830 .0685 .0566 .775 .782 .002213 101. 3 1, 270 530 828 .0570 .0568 .780 .775 .782 .002213 101. 1 1, 215 457 .771 .0526 .0565 .780 .782 .002213 101. 1 1, 215 457 .771 .0526 .0535 .815 .901 .002213 101. 1 1, 160 .305 .718 .0479 .0538 .815 .801 .002213 101. 1 1, 160 .305 .718 .0479 .0508 .853 .804 .002213 101. 1 1, 160 .305 .718 .0479 .0508 .853 .804 .002213 101. 1 1, 160 .305 .718 .0479 .0508 .853 .804 .002213 101. 1 1, 160 .305 .718 .0479 .0508 .853 .804 .002205 .101. 0 1, 100 .341 .074 .0441 .0496 .309 .810 .002205 .101. 0 1, 100 .341 .074 .0471 .0481 .0496 .309 .810 .002205 .100. 8 1, 050 .293 .640 .0399 .0483 .300 .808 .002205 .100. 8 1, 050 .293 .640 .0399 .0483 .300 .808 .002205 .100. 8 1, 050 .239 .500 .0335 .0449 .032 .820 .002205 .100. 8 1, 010 .241 .600 .0342 .0411 .978 .800 .002205 .100. 8 .002205 .100. 8 1, 010 .241 .600 .0342 .0411 .978 .812 .002205 .100. 4 .860 .800 .38 .470 .00195 .00103 .1220 .229 .002221 .70. 5 1, 535 .999 .1, 428 .0857 .00595 .472 .589 .002221 .70. 5 1, 535 .999 .1, 428 .0857 .00595 .472 .589 .002224 .72. 3 1, 550 .1, 007 .1, 453 .0859 .0993 .474 .887 .002224 .72. 3 1, 550 .1, 007 .1, 457 .0861 .0831 .438 .554 .002224 .67. 0 1, 535 .1, 005 .1, 457 .0861 .0831 .438 .554 .002224 .67. 0 1, 535 .1, 005 .1, 457 .0861 .0831 .438 .554 .002224 .67. 0 1, 535 .1, 005 .1, 457 .0861 .0831 .438 .554 .002224 .67. 0 1, 535 .1, 005 .1, 457 .0861 .0831 .438 .554 .002224 .67. 0 1, 535 .1, 005 .1, 457 .0861 .0831 .438 .554 .002224 .67. 0 1, 535 .1, 005 .1, 457 .0861 .0831 .438 .554 .002224 .67. 0 1, 535 .1, 005 .1, 457 .0861 .0831 .438 .554 .002224 .67. 0 1, 535 .1, 005 .1, 457 .0861 .0831 .438 .554 .002224 .67. 0 1, 535 .1, 005 .1, 457 .0861 .0831 .438 .554 .002224 .67. 0 1, 535 .1, 005 .1, 457 .0861 .0831 .438 .554 .002224 .67. 0 1, 535 .1, 005 .1, 457 .0861 .0831 .438 .554 .002224 .67. 0 1, 535 .1, 005 .1, 457 .0861 .0831 .438 .554 .002224 .67. 0 1, 535 .1, 005 .1, 457 .0861 .0831 .438 .554 .002224 .67. 0 1, 535 .1, | | 101.3 | | | | 0,000 | 1 .0010 | | |
| . 002213 101. 3 1,280 581 830 .0565 0560 7775 782 002213 101. 1 1,216 477 771 .0523 0535 811 794 002213 101. 1 1,220 460 772 .0523 0535 811 794 002213 101. 1 1,220 460 772 .0523 0535 811 794 002213 101. 1 1,160 395 718 0479 0508 833 800 002213 101. 1 1,160 395 716 0475 0508 833 800 002213 101. 1 1,160 395 716 0475 0508 833 800 002205 101. 0 1,100 341 674 0441 0496 399 810 002205 101. 0 1,100 341 674 0441 0496 399 810 002205 101. 0 1,100 342 676 0437 0451 899 810 002205 101. 0 1,100 203 640 0399 0453 830 808 002205 101. 0 1,090 203 640 0399 0453 830 808 002205 101. 0 1,090 203 644 0389 0449 332 801 002205 100. 8 1,010 241 600 0342 0441 932 801 002205 100. 8 1,010 241 600 0342 0441 932 801 002205 100. 8 1,010 241 600 0342 0441 932 801 002205 100. 8 1,010 241 600 0342 0441 932 801 002205 100. 8 1,010 241 600 0342 0411 975 812 002205 99. 6 800 88 470 00121 0211 1,140 654 002205 99. 6 800 88 470 00121 0211 1,140 654 002221 76. 5 1,585 999 1,423 0857 0057 472 812 002224 72. 3 1,590 1,007 1,455 0864 0633 445 562 002224 72. 3 1,590 1,007 1,487 0861 0881 438 854 002224 67. 0 1,585 1,009 1,487 0861 0881 438 854 002224 67. 0 1,595 1,009 1,487 0861 0881 438 854 002225 86. 0 1,605 1,007 1,487 0884 0683 441 629 002225 86. 0 1,605 1,007 1,487 0884 0683 441 629 002225 86. 0 1,605 1,007 1,455 0884 0673 387 609 002226 86. 0 1,605 1,007 1,455 0884 0683 441 629 002225 86. 0 1,605 1,007 1,457 0885 0676 333 494 002225 86. 0 1,605 1,007 1,457 0885 0676 333 494 002225 86. 0 1,605 1,007 1,457 0885 0676 333 494 002225 86. 0 1,605 1,007 1,457 0885 0676 333 494 002225 86. 0 1,605 1,007 1,457 0885 0676 333 494 002225 86. 0 1,605 1,007 1,457 0885 0676 333 494 002225 86. 0 1,605 1,007 1,457 0885 0676 333 494 002225 86. 0 1,605 1,007 1,457 0885 0676 333 494 002225 86. 0 1,605 1,007 1,457 0885 0676 333 494 002225 86. 0 1,605 1,007 1,457 0885 0676 333 494 002225 86. 0 1,605 1,007 1,457 0885 0676 333 445 185 002225 86. 0 1,605 1,007 1,457 0885 0676 333 445 185 002227 17. 86 1,600 1,007 1,452 0884 0672 33 445 185 002225 17. 76 1,600 1,007 1,452 0 | | 101.3 | 1, 335 | 605 | | 0603 | | | |
| | . 002213 | 101.3 | | 581 | | 0565 | | | |
| . 002213 101.1 1,215 457 771 .0528 .0535 .815 .801 .002213 101.1 1,220 460 772 .0523 .0535 .815 .801 .002213 101.1 1,160 .395 718 .0479 .0508 .833 .804 .002213 101.1 1,160 .395 716 .0476 .0508 .833 .804 .002225 101.0 1,100 .341 674 .0476 .0508 .833 .804 .002205 101.0 1,110 .342 676 .0437 .0451 .899 .810 .002205 100.8 1,050 .293 649 .0399 .0483 .300 .808 .002205 101.0 1,090 .293 659 .0399 .0483 .300 .820 .002205 101.0 1,090 .239 .649 .0399 .0483 .300 .820 .002205 100.8 1,050 .293 649 .0399 .0458 .300 .820 .002205 100.8 1,010 .241 600 .0396 .0449 .032 .801 .002205 100.8 1,010 .241 600 .0342 .0411 .075 .812 .002205 .008 .008 .008 .008 .008 .008 .008 .0 | . 002213 | 101.3 | | | 828 | . 0570 | | | |
| .002213 101.1 1,220 460 7772 0,522 0,535 811 774 002213 101.1 1,160 395 718 0479 0,508 833 800 002213 101.1 1,160 395 716 0,476 0,508 833 800 0,002205 101.0 1,100 341 674 0,441 0,496 399 810 0,002205 101.0 1,110 342 676 0,437 0,451 890 808 0,002205 101.0 1,100 341 674 0,441 0,496 399 810 0,002205 101.0 1,100 239 640 0,399 0,453 890 808 0,002205 101.0 1,090 239 806 0,336 0,441 890 822 801 0,002205 100.7 1,090 239 806 0,336 0,441 8932 801 0,002205 100.8 1,010 241 800 0,342 0,411 975 812 0,002205 100.8 1,010 241 800 0,342 0,411 975 812 0,002205 100.4 860 90 499 0,121 0,002 0,4 860 90 499 0,002 0,4 860 90 499 0,002 0,002 0,002 0,4 860 90 499 0,002 0, | . 002213 | | | 457 | | 0526 | | | |
| .002213 101.1 1,160 395 718 0479 0508 883 804 002215 101.0 1,160 395 716 0476 0508 883 804 002205 101.0 1,100 341 674 0441 0496 899 810 002205 101.0 1,110 342 676 0487 0481 890 808 808 002205 100.7 1,110 342 676 0487 0481 890 808 808 002205 100.7 1,090 220 634 0399 0488 500 808 002205 100.7 1,090 220 634 0399 0488 500 808 002205 100.7 1,090 220 634 0386 0449 932 801 002205 100.7 1,000 239 590 0385 0449 932 801 002205 100.8 1,010 241 600 0342 0411 978 812 002205 100.4 880 90 409 0121 0211 1,140 608 781 002205 90.6 800 38 470 00195 01033 1,220 229 00221 76.5 1,585 999 1,428 0857 0487 0487 1,520 229 002221 76.5 1,585 999 1,428 0857 0857 0472 589 002221 76.5 1,585 999 1,428 0857 0487 0487 445 589 002224 772.3 1,590 1,007 1,453 0859 0693 474 587 002224 772.3 1,590 1,007 1,453 0854 0683 441 529 002224 67.0 1,585 1,005 1,487 0861 0881 438 554 002224 67.0 1,585 1,005 1,487 0861 0681 438 554 002224 67.0 1,585 1,005 1,487 0861 0681 438 554 002224 67.0 1,585 1,005 1,487 0861 0681 438 554 002224 67.0 1,585 1,005 1,487 0861 0681 438 554 002224 67.0 1,585 1,005 1,487 0864 0683 441 529 002224 67.0 1,585 1,005 1,487 0864 0683 441 529 002224 67.0 1,585 1,005 1,487 0861 0681 438 554 002224 67.0 1,585 1,005 1,487 0861 0681 438 554 002224 67.0 1,585 1,005 1,487 0864 0683 441 529 002224 67.0 1,585 1,005 1,487 0864 0673 387 569 002224 67.0 1,585 1,005 1,487 0864 0673 387 569 002224 67.0 1,585 1,005 1,487 0861 0681 438 554 002225 58.0 1,600 1,007 1,487 0885 0673 387 569 002225 57.7 1,600 1,007 1,487 0885 0673 387 569 002225 57.7 1,600 1,007 1,487 0885 0673 383 491 00225 57.7 1,600 1,007 1,451 0881 0681 0681 438 554 00225 57.7 1,600 1,007 1,452 0885 0673 383 491 00225 57.7 1,600 1,007 1,451 0881 0681 0681 438 554 00225 57.7 1,600 1,007 1,451 0881 0681 0681 438 554 00225 57.7 1,600 1,007 1,451 0881 0681 0681 438 554 00225 57.7 1,600 1,007 1,451 0881 0681 0681 438 554 00225 57.7 1,600 1,007 1,451 0881 0681 0681 438 554 00225 57.7 1,600 1,007 1,451 0881 0681 0681 438 554 00225 57.7 1,600 1,007 1,407 1,407 1,407 1,407 1,407 1,407 1,407 1, | . 002218 | 101.1 | 1, 220 | | | . 0523 | 0536 | | |
| .002213 101.1 | | 101. I | 1, 160 | | 718 | | OFOR | | |
| .002205 101.0 1,100 341 674 0441 0426 899 810 002205 101.0 1,110 342 676 0437 0431 890 80 80 002205 101.0 1,000 290 634 0399 0458 300 80 80 002205 100.7 1,000 239 590 0336 0449 832 801 002205 100.7 1,000 239 590 0336 0441 932 801 002205 100.8 1,010 241 600 0342 0411 978 812 002205 100.4 860 80 499 0121 021 1,100 80 80 499 0121 1,100 80 80 80 80 80 80 80 80 80 80 80 80 8 | | 101.1 | 1.160 | | | | 0,000 | .000 | .003 |
| .002205 100. 8 1,050 293 640 0339 0483 390 808 002206 100. 8 1,050 290 634 0336 0449 332 801 002205 100. 8 1,050 290 634 0336 0449 332 801 002205 100. 8 1,010 241 600 0342 0411 975 812 002205 100. 8 1,010 241 600 0342 0411 975 812 002205 100. 8 1,010 241 600 0342 0411 975 812 002205 100. 4 860 80 499 0121 0211 1,140 654 002205 100. 4 860 80 499 0121 0211 1,140 654 002205 99. 6 800 88 470 0195 01033 1,220 229 002221 76. 5 1,585 999 1,426 0857 0057 472 889 002224 72. 8 1,590 1,007 1,483 0864 0683 474 887 002224 72. 8 1,590 1,007 1,483 0864 0683 4415 862 002224 71. 5 1,590 1,007 1,483 0864 0683 441 854 002224 67. 0 1,585 1,009 1,487 0878 0883 411 829 002224 67. 0 1,585 1,009 1,487 0878 0883 411 829 002224 67. 0 1,585 1,009 1,487 0878 0883 411 829 002224 67. 0 1,585 1,009 1,487 0878 0883 411 829 002224 67. 0 1,585 1,009 1,487 0878 0883 411 829 002224 67. 0 1,585 1,009 1,487 0878 0883 411 829 002224 67. 0 1,585 1,009 1,487 0878 0883 411 829 002224 67. 0 1,585 1,009 1,487 0878 0883 411 829 002224 67. 0 1,585 1,009 1,487 0878 0883 411 829 002224 67. 0 1,585 1,009 1,487 0878 0883 411 829 002228 81. 9 1,600 1,007 1,483 0884 0672 405 530 002228 81. 9 1,600 1,007 1,513 0885 0676 383 494 002225 88. 0 1,605 1,015 1,014 1,537 0885 0676 383 494 002225 57. 7 1,600 1,009 1,613 0881 0881 0883 438 00227 17. 88 1,500 1,009 1,613 0881 0881 0833 458 002287 17. 88 1,500 1,009 1,613 0881 0881 0833 458 002287 17. 88 1,500 1,009 1,613 0881 0881 0833 458 002287 17. 88 1,500 1,009 1,613 0881 0881 0833 458 002287 17. 88 1,500 1,009 1,613 0881 0881 0833 458 002287 17. 88 1,500 1,009 1,613 0881 0881 0853 445 | | 10L 0 | 1, 100 | 341 | | | 0406 | | - out |
| .002205 100.0 8 1,050 220 640 0399 0458 230 820 002205 100.7 1,050 230 634 0385 0449 332 801 002205 100.8 1,010 241 600 0335 04416 385 796 02205 100.8 1,010 241 600 0342 0411 375 812 002205 100.4 860 90 499 0121 0211 1,140 654 002205 99.6 800 88 470 00221 76.5 1,585 999 1,428 0857 0033 1,220 229 002221 76.5 1,585 999 1,428 0857 0033 1,220 229 002221 76.5 1,585 999 1,428 0857 0033 1,220 229 002221 76.5 1,585 999 1,428 0857 0033 1,220 229 002221 76.5 1,585 999 1,428 0857 0033 1,220 229 002221 76.5 1,585 999 1,428 0857 0033 1,220 229 002221 76.5 1,585 999 1,428 0857 0033 1,220 229 002221 76.5 1,585 1,005 1,487 0850 0833 445 562 002224 67.0 1,585 1,005 1,487 0861 0881 4438 354 002224 67.0 1,585 1,005 1,487 0861 0881 4438 354 002224 67.0 1,585 1,009 1,487 0861 0881 4438 354 002224 67.0 1,585 1,009 1,487 0861 0881 4438 354 002224 67.0 1,585 1,009 1,487 0861 0881 4438 354 002224 67.0 1,585 1,009 1,487 0864 0672 405 530 002228 61.9 1,600 1,007 1,482 0864 0672 405 530 002228 61.9 1,600 1,007 1,451 0881 0873 0873 387 509 002228 61.9 1,600 1,007 1,452 0884 0673 387 509 002228 61.9 1,600 1,007 1,451 0881 0873 0873 387 509 002228 57.7 1,600 1,012 1,529 0882 0876 323 461 002225 17.8 1,600 1,012 1,529 0882 0876 323 451 002225 17.8 1,600 1,012 1,529 0882 0850 383 458 002227 17.8 1,600 1,010 1,011 1,611 0881 0756 1145 1456 | | 101.0 | 1, 110 | 342 | | | 1810 | | |
| .002205 100. 7 1, 030 230 504 0335 0446 382 380 002205 100. 7 1, 030 230 504 00335 0416 985 796 002205 100. 8 1, 010 241 600 0342 0411 975 312 002205 100. 8 900 149 388 0224 0306 1, 068 781 002205 90. 6 800 38 470 00195 01033 1, 220 229 002207 76. 5 1, 585 999 1, 428 0857 0987 472 589 00221 76. 5 1, 585 999 1, 428 0857 0987 472 589 002221 76. 5 1, 585 1, 005 1, 457 0861 0881 438 554 002224 67. 0 1, 585 1, 005 1, 457 0861 0881 438 554 002224 67. 0 1, 585 1, 005 1, 457 0861 0881 438 554 002224 66. 3 1, 500 1, 007 1, 453 0864 0673 445 560 002224 67. 0 1, 585 1, 005 1, 457 0861 0881 438 554 002224 66. 3 1, 500 1, 007 1, 453 0864 0673 445 560 002224 67. 0 1, 585 1, 005 1, 457 0861 0881 438 554 002224 66. 3 1, 600 1, 007 1, 452 0864 0673 445 560 002225 68. 6 1, 610 1, 017 1, 452 0864 0673 387 683 411 529 002225 58. 6 1, 610 1, 013 1, 613 0880 0673 387 600 002225 57. 7 1, 600 1, 012 1, 529 0885 0673 387 491 002225 57. 7 1, 600 1, 012 1, 529 0885 0873 383 491 002225 17. 86 1, 500 1, 010 1, 151 1, 529 0885 0873 383 491 002257 17. 86 1, 500 1, 010 1, 151 1, 529 0882 0883 383 453 002257 17. 86 1, 500 1, 010 1, 011 1, 529 0885 0873 383 491 002257 17. 86 1, 500 1, 010 1, 011 1, 529 0885 0873 383 491 002257 17. 86 1, 500 1, 010 1, 011 1, 529 0882 0800 383 453 453 002257 17. 86 1, 500 1, 010 1, 011 1, 529 0885 0873 383 491 002257 17. 86 1, 500 1, 010 1, 011 1, 011 0881 0756 1145 1456 | | 100.8 | | 293 | 640 | . 0399 | | | |
| .002205 100. 8 1,010 241 600 0342 0341 075 812 .002205 100. 4 860 90 499 0121 0211 1,100 8 781 .002205 99. 6 800 88 470 00195 01033 1,220 229 .002221 76. 5 1,585 999 1,428 0857 0057 472 559 .002221 76. 5 1,580 998 1,428 0857 0057 472 559 .002221 76. 5 1,580 998 1,428 0857 0057 472 559 .002224 72. 3 1,590 1,007 1,453 0864 0683 445 562 .002224 67. 0 1,595 1,006 1,457 0861 0681 438 554 .002224 67. 0 1,595 1,006 1,457 0861 0681 438 554 .002224 67. 0 1,595 1,007 1,452 0878 0683 441 520 .002224 67. 0 1,595 1,009 1,457 0878 0683 441 520 .002225 68. 0 1,600 1,007 1,452 0878 0683 441 520 .002225 68. 0 1,600 1,007 1,453 0863 0673 387 609 .002225 57. 7 1,600 1,012 1,529 0882 0676 383 494 .002257 17. 86 1,500 1,012 1,529 0882 0876 383 494 .002257 17. 86 1,500 1,012 1,529 0882 0856 383 494 .002257 17. 86 1,500 1,012 1,529 0882 0850 383 494 .002257 17. 86 1,500 1,012 1,529 0882 0850 383 495 .002257 17. 86 1,500 1,012 1,529 0882 0850 383 455 0858 0856 183 494 .002257 17. 86 1,500 1,012 1,529 0882 0850 383 455 0000000000000000000000000000000000 | | 101.0 | | 290 | | . 0386 | | 030 | 901 |
| .002205 100. 8 1,010 241 600 0342 0341 075 812 .002205 100. 4 860 90 499 0121 0211 1,100 8 781 .002205 99. 6 800 88 470 00195 01033 1,220 229 .002221 76. 5 1,585 999 1,428 0857 0057 472 559 .002221 76. 5 1,580 998 1,428 0857 0057 472 559 .002221 76. 5 1,580 998 1,428 0857 0057 472 559 .002224 72. 3 1,590 1,007 1,453 0864 0683 445 562 .002224 67. 0 1,595 1,006 1,457 0861 0681 438 554 .002224 67. 0 1,595 1,006 1,457 0861 0681 438 554 .002224 67. 0 1,595 1,007 1,452 0878 0683 441 520 .002224 67. 0 1,595 1,009 1,457 0878 0683 441 520 .002225 68. 0 1,600 1,007 1,452 0878 0683 441 520 .002225 68. 0 1,600 1,007 1,453 0863 0673 387 609 .002225 57. 7 1,600 1,012 1,529 0882 0676 383 494 .002257 17. 86 1,500 1,012 1,529 0882 0876 383 494 .002257 17. 86 1,500 1,012 1,529 0882 0856 383 494 .002257 17. 86 1,500 1,012 1,529 0882 0850 383 494 .002257 17. 86 1,500 1,012 1,529 0882 0850 383 495 .002257 17. 86 1,500 1,012 1,529 0882 0850 383 455 0858 0856 183 494 .002257 17. 86 1,500 1,012 1,529 0882 0850 383 455 0000000000000000000000000000000000 | | 100.7 | 1,000 | 239 | 596 | . 0336 | | | |
| .002205 | | | | 241 | 600 | . 0342 | | | |
| .002205 90.6 800 83 470 .0195 .01033 1.220 .229 .002221 76.5 1,585 999 1,428 .0857 .0057 .472 .889 .002224 77.5 1,580 998 1,428 .0857 .0057 .472 .889 .002224 72.3 1,590 1,007 1,483 .0864 .0833 .445 .562 .002224 67.0 1,595 1,006 1,467 .0861 .0681 .438 .554 .002224 67.0 1,595 1,006 1,467 .0861 .0681 .438 .554 .002224 67.0 1,595 1,009 1,487 .0864 .0633 .411 .629 .002224 67.0 1,595 1,009 1,487 .0864 .0633 .411 .629 .002224 66.3 1,600 1,007 1,482 .0864 .0672 .405 .530 .002224 66.3 1,600 1,007 1,482 .0864 .0672 .405 .530 .002228 61.9 1,600 1,009 1,513 .0830 .0673 .387 .609 .002228 61.9 1,600 1,009 1,513 .0880 .0673 .387 .609 .002228 57.7 1,600 1,009 1,513 .0880 .0673 .387 .609 .002257 57.7 1,600 1,012 1,529 .0882 .0880 .383 .491 .002257 17.86 1,500 1,012 1,529 .0882 .0880 .383 .481 .002257 17.86 1,500 1,010 1,611 .0881 .0881 .0755 .1145 .1456 | | | | | 538 | . 0224 | .0306 | | |
| .002221 76.5 1,585 999 1,428 0857 0957 472 589 002221 76.5 1,585 998 1,424 0857 0957 472 589 002221 76.5 1,585 998 1,424 0859 0968 474 687 00224 72.3 1,590 1,007 1,453 0864 0053 445 562 002224 71.5 1,595 1,005 1,457 0861 0681 438 554 002224 67.0 1,585 1,005 1,457 0861 0681 438 554 002224 67.0 1,585 1,005 1,487 0861 0681 438 554 002224 66.3 1,500 1,007 1,482 0864 0672 405 560 002225 63.6 1,610 1,013 1,613 0863 0673 387 600 002225 63.6 1,610 1,007 1,482 0864 0672 387 600 00225 57.7 1,600 1,012 1,537 0885 0673 387 494 002257 17.56 1,600 1,012 1,529 0885 0676 383 491 002257 17.56 1,600 1,012 1,529 0885 0676 383 491 002257 17.56 1,600 1,012 1,529 0885 0873 383 491 002257 17.56 1,500 1,012 1,529 0882 0880 383 453 002257 17.56 1,500 1,012 1,529 0882 0080 383 453 002257 17.56 1,500 1,012 1,511 0881 0755 1145 1456 | | 100.4 | 860 | | | | .0211 | | |
| .002221 76.5 1,585 999 1,428 0887 0987 472 589 002224 72.3 1,590 988 1,424 0859 0989 698 474 587 002224 72.3 1,590 1,007 1,483 0864 0683 445 562 002224 71.5 1,590 1,007 1,483 0864 0683 445 562 002224 66.3 1,590 1,497 0878 0683 0881 438 554 002224 66.3 1,600 1,007 1,487 0878 0683 411 529 002224 66.3 1,600 1,007 1,482 0864 0672 405 520 002224 66.3 1,600 1,007 1,482 0864 0672 405 520 002228 81.9 1,600 1,007 1,613 0880 0673 387 509 002228 81.9 1,600 1,009 1,613 0880 0673 387 509 002228 57.7 1,600 1,009 1,613 0880 0673 387 609 002225 57.7 1,600 1,014 1,527 0885 0676 383 461 002225 17.8 1,600 1,012 1,529 0882 0680 383 458 002227 17.8 1,600 1,012 1,529 0882 0680 383 458 002227 17.8 1,500 1,500 1,611 0981 0755 1148 1486 | | 99.6 | 800 | | | .00195 | . 01033 | T. 220 | 326 |
| .002224 72.3 1,590 1,007 1,453 0,864 0,683 474 887 0,002224 71.5 1,590 1,007 1,453 0,864 0,683 474 887 0,002224 67.0 1,595 1,006 1,457 0,861 0,681 438 8,554 0,002224 67.0 1,595 1,006 1,457 0,861 0,681 438 8,554 0,002224 66.3 1,600 1,007 1,482 0,864 0,672 4,005 3,50 0,002228 63.6 1,610 1,013 1,613 0,673 0,673 3,877 0,002228 61.9 1,600 1,009 1,513 0,869 0,673 3,877 0,002257 68.0 1,605 1,014 1,537 0,885 0,673 3,878 4,94 0,002257 17.56 1,600 1,012 1,529 0,882 0,673 3,833 4,91 0,002257 17.56 1,500 1,012 1,529 0,882 0,673 3,833 4,91 0,002257 17.56 1,500 1,01 | .002221 | 78.5 | 1, 585 | 999 | 1, 426 | .0857 | | | |
| .002224 71.6 1,596 1,006 1,457 0864 0683 445 562 002224 67.0 1,595 1,006 1,457 0861 0681 438 554 002224 66.3 1,500 1,007 1,487 0878 0683 411 529 002228 63.6 1,600 1,007 1,482 0864 0672 405 530 002228 63.6 1,610 1,013 1,513 0873 0670 387 609 002228 61.9 1,600 1,009 1,513 0873 0670 387 609 002228 61.9 1,600 1,009 1,513 0880 0673 387 609 00225 58.0 1,005 1,005 1,014 1,537 0880 0673 387 494 00225 57.7 1,600 1,012 1,529 0882 0676 353 461 00225 17.8 1,500 1,012 1,529 0882 0680 353 458 00225 17.8 1,500 1,012 1,529 0882 0680 353 458 00225 17.8 1,500 1,010 1,611 0981 0756 1146 1,458 | .002221 | | | 998 | 1, 424 | . 0859 | . 0693 | | 587 |
| .002224 67.0 1,593 1,009 1,487 0878 0683 111 229 002224 66.3 1,600 1,007 1,482 0864 0672 405 530 002228 63.6 1,610 1,013 1,613 0873 0870 387 609 002228 61.9 1,600 1,009 1,513 0873 0870 387 609 00225 58.0 1,005 1,014 1,637 0880 0873 378 494 00225 58.0 1,005 1,014 1,637 0885 0676 383 461 00225 57.7 1,600 1,012 1,529 0882 0680 383 461 00225 17.86 1,590 1,019 1,611 0981 0756 383 458 00225 17.86 1,590 1,019 1,611 0981 0756 1146 1458 | | 72.8 | 1,590 | 1,007 | 1, 453 | .0864 | . 0683 | | .562 |
| .002228 63.6 1, 610 1, 1013 1, 613 0864 0672 405 530 002228 61.9 1,600 1,009 1,613 0873 0670 387 609 002228 61.9 1,600 1,009 1,613 0880 0670 387 609 00225 68.0 1,005 1,014 1,637 0880 0676 383 494 00225 17.86 1,600 1,012 1,529 0882 0680 383 461 00225 17.86 1,500 1,019 1,611 0981 0786 1146 1486 | | 71. 6 | | 1,005 | L, 457 | . 0861 | . 0681 | | |
| .002228 63.6 1, 610 1, 1013 1, 613 0864 0672 405 530 002228 61.9 1,600 1,009 1,613 0873 0670 387 609 002228 61.9 1,600 1,009 1,613 0880 0670 387 609 00225 68.0 1,005 1,014 1,637 0880 0676 383 494 00225 17.86 1,600 1,012 1,529 0882 0680 383 461 00225 17.86 1,500 1,019 1,611 0981 0786 1146 1486 | | 07.0 | | 7 003 | 1,487 | | . 0683 | .411 | |
| .002225 68.0 1,600 1,009 1,613 08673 0670 387 609 002252 68.0 1,600 1,009 1,613 0880 0673 878 494 002252 57.7 1,600 1,012 1,529 0882 0676 383 461 002252 17.8 1,600 1,012 1,529 0882 0676 383 481 002257 17.8 1,600 1,012 1,529 0882 0880 383 483 002257 17.8 1,500 1,01 | | 00.8 | 1,000 | 1,007 | | | .0672 i | 405 | . 520 |
| .002252 88.0 1,605 1,014 1,637 0885 0676 383 491 002252 67.7 1,600 1,012 1,529 0882 0680 383 458 002257 17.86 1,530 1,010 1,611 0981 0756 1146 11486 | | 81 G | | 1,000 | 1- 013 | .0873 | .0670 } | .387 | |
| .002252 57.7 1,600 1,012 1,529 .0882 .0880 .353 .458 .002257 17.86 1,530 1,019 1,611 .0981 .0756 .1146 .1486 | | | 1,000 | 1,009 | 1, 513 | | | | . 494 |
| 002257 17.86 1.520 1.019 1.611 0081 0756 1145 1496 | | | | 1,014 | 1,007 | .0885 | | . 353 | |
| 002257 17 98 1 505 1 015 1 016 1 0001 10700 1140 1150 | | | | 1,012 | | | | | |
| | | | | | | | | | |
| | | | 1,040 | r4 019 | T 013 | .0970 | . 0749 | . 1149 | . 149 |

TABLE II TEST RESULTS

PROPELLER 4412-15.5° AT 0.75R. 0° YAW

| P V N Q T Cr Cr V πD q 0.002310 83.6 1,890 789 866 0.0576 0.0366 0.33 0.681 .002310 84.1 1,890 789 870 .0579 .0366 0.33 0.681 .002310 88.6 1,890 788 826 .0550 .0366 .488 .708 .002310 88.0 1,900 768 826 .0550 .0356 .488 .708 .002307 93.5 1,890 771 776 .5055 .0383 .485 .701 .002307 93.5 1,890 781 .0588 .0340 .494 .723 .002304 102.8 1,890 669 688 .0439 .0311 .531 .750 .002304 102.2 1,800 571 545 .0401 .0233 .557 .764 .002304 101.2 1,700 <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> | | | | | | | | | |
|---|--|---|---|---|---|---|---|--|--|
| 0.002310 | ٩ | | | | | Cr | C. | | ¥ |
| .002312 61.2 1,890 859 992 .0659 .0338 .817 .525 .002312 61.2 1,890 860 994 .0660 .0399 .817 .525 | 002310 002310 002310 002307 002307 002304 002304 002304 002304 002307 002297 002297 002297 002297 002297 002297 002297 002297 002297 002297 002297 002297 | 84. I 88. 0 93. 7 93. 5 102. 8 102. 8 101. 2 101. 2 101. 0 100. 0 99. 0 76. 6 72. 0 66. 7 61. 7 | L.890 1,890 1,890 1,890 1,890 1,890 1,890 1,810 1,700 1,495 1,490 1,400 1,400 1,400 1,400 1,400 1,400 1,400 1,400 1,400 1,400 1,400 1,400 1,400 1,400 1,400 | 788 777 884 777 888 772 888 888 888 888 888 888 888 | 5.8855.5889.588988888888888888888888888 | . 0579 . 0550 . 0544 . 0505 . 0439 . 0431 . 0401 . 0335 . 0350 . 0300 . 0200 . 0200 . 0200 . 01334 . 0630 . 0601 . 0621 . 0621 . 0632 . 0630 | 0366 -0356 -0352 -0338 -0339 -0331 -0311 -0213 -0220 -0266 -0242 -0215 -01552 -0377 -0378 -0378 -0379 -0378 -0379 -0378 -0379 -0378 -0379 -0378 | 35 458 454 454 454 454 454 532 551 557 549 582 620 691 746 836 836 397 375 375 375 375 375 375 375 376 377 | .688 .708 .701 .723 .723 .751 .750 .764 .755 .766 .765 .766 .765 .766 .764 .730 .843 .256 .643 .643 .653 .615 .615 .652 .652 |

TABLE II—Continued

TEST RESULTS

PROPELLER 4412-15.5° AT 0.75R. 5° YAW

| ρ | <i>V</i> m. p. h. | N r. p. m. | Q lb. ft. | T' lb. | Ст | C₽ | V nD | ¥ . | |
|---|---|---|--|--|--|--|--|--|--|
| 0. 002274 .002774 .002274 .002274 .002274 .002261 .002261 .002261 .002261 .002261 .002260 .002260 .002260 .002260 .002260 .002260 .002260 .002261 .002261 .002261 .002261 .002261 .002261 | 88. 8 88. 8 93. 0 96. 1 95. 7 105. 5 105. 5 105. 5 104. 0 75. 0 82. 0 82. 0 82. 0 104. 8 104. 8 104. 8 | 1,890 1,890 1,890 1,870 1,870 1,870 1,870 1,820 1,520 1,705 1,705 1,870 1,870 1,880 1,900 1,820 1,900 1,820 1,900 1,820 1,870 1,880 1,870 1,880 1,870 1,880 1,870 1,880 1,870 1,870 1,870 1,880 1,870 1,80 1,80 1,80 1,80 1,80 1,80 1,80 1,8 | 743 744 702 708 680 655 656 554 866 547 799 795 793 364 268 123 487 798 | 1, 360 1, 360 1, 273 1, 220 1, 227 1, 240 1, 145 1, 047 1, 047 1, 047 1, 047 1, 504 1, 459 1, | 0.0537 -0537 -0495 -0495 -0493 -0493 -0427 -0426 -0392 -0392 -0393 -0623 -0623 -0556 -0598 -0214 -011465 -00705 -00258 -0623 - | 0.0352 .0352 .0353 .0353 .0328 .0307 .0259 .0260 .0261 .0394 .0370 .0270 | 0.460 480 480 484 503 501 545 545 567 567 567 596 390 422 424 637 630 630 787 630 787 838 | 0. 701 -701 -726 -726 -728 -724 -750 -754 -755 -755 -755 -755 -755 -750 -755 -750 -755 -750 -755 -750 -750 | |
| .002268 .002271 .002271 .002271 .002271 | 70.3 68.1 64.8 60.7 60.7 | 1,870 1,870 1,870 1,880 1,870 | 801 807 817 812 813 | 1,585 1,561 1,563 1,586 1,587 | .0648 .0648 .0652 .0660 | .0356 .0358 .0394 .0358 .0391 | .368 .841 .339 .316 .317 | .608 .570 .558 .531 .535 | |

TABLE II—Continued

TEST RESULTS

PROPELLER 4412-15.5° AT 0.75R. 10° YAW

| P | <i>y</i> m. p b. | <i>N</i> r. p. m | lb. ft. | T lb. | C _T | C _P | $\frac{V}{nD}$ | 7 |
|--|---|---|--|--|---|---|---|---|
| 0.002288 002285 002285 002285 002287 002277 002277 002271 002271 002271 002271 002271 002284 002284 002284 002286 002287 002287 002287 002287 002287 | 87. 4 86. 7 91. 5 95. 6 95. 6 104. 9 104. 8 103. 5 103. 8 103. 8 102. 8 102. 5 102. 6 78. 0 78. 7 | 1,890 1,890 1,890 1,880 1,880 1,900 1,900 1,500 | 7717799 7810 7700 8556 8544 4452 8552 8552 8552 8552 8552 8552 | 820 820 827 757 761 712 639 513 505 293 191 198 881 199 198 881 199 929 929 934 | 0. 0551 .0552 .0509 .0511 .0456 .0457 .0427 .0334 .0334 .0250 .0250 .0214 .01720 .0309 .00309 | 0. 0362 - 0363 - 0342 - 0343 - 0333 - 0307 - 0224 - 0224 - 0224 - 0224 - 0224 - 0225 - 0200 - 01350 - 00352 - 0352 - 0352 | n.D 0.452 -443 -473 -473 -473 -473 -498 -549 -540 -577 -599 -539 -539 -715 -589 -639 -715 -817 -817 -817 -818 -818 -818 | 0. 688 . 684 . 705 . 704 . 726 . 728 . 743 . 751 . 763 . 769 . 764 . 778 . 786 . 799 . 285 . 285 . 645 . 625 . 625 . 625 |
| .002279 .002282 .002282 | 67.4 61.7 62.1 | 1, 890 1, 870 1, 880 | 830 835 832 | 996 1,020 1,023 | .0678 .0700 .0696 | .0339 .0390 .0401 .0395 | .348 .323 .324 | .600 .564 .571 |

TABLE II—Continued

TEST RESULTS

PROPELLER 4412-15.5° AT 0.75R. 15° YAW

| | | | | | | | | |
|----------|----------------------|----------------------|--------------|------------|----------------|----------------|---------|-------------|
| P | <i>V</i> m. p. h. | <i>N</i> r. p. m. | Q lb. ft. | Ib. | C _T | C _P | V nD | 7 |
| 0.00231 | 89.0 | 1.900 | 773 | 804 | 0.0540 | 0.0363 | 0.458 | 0.682 |
| .00231 | 89.0 | 1,900 | 773 | 806 | . 0542 | . 0363 | 458 | .684 |
| .00231 | 92.6 | 1,890 | 728 | 747 | . 0507 | . 0346 | 479 | .703 |
| .00231 | 92.4 | 1.890 | 727 | 748 | . 0508 | . 0345 | .478 | .705 |
| .002307 | 95.5 | 1.890 | 692 | 698 | .0477 | .0330 | .494 | .714 |
| .002307 | 94.2 | 1,880 | 692 | 709 | _0490 | .0334 | .490 | .719 |
| .002304 | 103.9 | 1,890 | 653 | 625 | .0428 | .0312 | . 587 | .737 |
| . 002304 | 103.7 | 1.890 | 659 | 632 | .0432 | .0314 | . 536 | .737 |
| . 002304 | 103.6 | 1,810 | 560 | 584 | .0398 | .0291 | . 560 | .766 |
| . 002304 | 103.3 | 1,810 | 560 | 532 | .0396 | .0291 | . 558 | .760 |
| .002304 | 102.9 | 1,690 | 442 | 395 | - 0337 | . 0264 | .596 | .761 |
| .002304 | 103.0 | 1,690 | 442 | 395 | . 0337 | .0264 | . 596 | .761 |
| .002297 | 103.0 | 1,600 | 364 | 311 | .0298 | .0244 | . 630 | .770 |
| .002297 | 103.0 | 1,600 | 367 | 312 | .0299 | . 0246 | . 630 | .765 |
| .002297 | 102.6 | 1,500 | 202 | 235 | . 0256 | .0225 | .669 | .769 |
| .002297 | 102.1 | 1,410 | 231 | 173 | .0213 | . 0200 | .708 | .755 |
| . 002297 | 101.9 | 1,300 | 1250 | 91 | .0132 | . 0152 | .766 | .665 |
| .002297 | 10L6 | 1, 210 | 94 | 87 | .0062 | .0110 | . 821 | .462 |
| . 002297 | 10L3 | I, 100 | 27 | —25 | 00507 | .00381 | .901 | |
| . 002309 | [8L.2 | 1,890 | 778 | 849 | .0575 | .0371 | . 420 | .650 |
| . 002309 | 81.4 | 1,890 | 776 | 836 | .0571 | .0370 | 421 | .650 |
| . 002309 | 75.9 | 1,890 | 808 | 899 | .0617 | .0385 | .393 | .627 |
| . 002309 | 75.8 | 1,890 | 809 | 893 | . 0610 | .0385 | .392 | .620 |
| . 002309 | 71.4 | 1,890 | 820 | 926 | .0633 | .0391 | . 369 | .597 |
| . 002309 | 71.1 | 1,200 | 824 | 929 | .0635 | .0389 | .366 | .597 |
| .002312 | 63.8 | 1,880 | 826 | 973 | .0672 | .0398 | . 332 | .560 |
| . 002312 | 63.9 | 1,890 | 826 | 976 | .0666 | .0391 | .331 | . 565 |
| .002312 | 59.5 | 1,880 | 881 | 999 | .0690 | .0400 | .310 | .535 |
| .002312 | 59.6 | 1,880 | 831 | 1,001 | .0691 | .0400 | .810 | . 586 |
| .002312 | 58.3 | 1,880 | 833 | 1,011 | .0699 | .0 <u>4</u> 01 | .303 | . 529 |
| .002312 | 55.8 | 1,880 | 836 | 1,022 | .0706 | .0402 | . 290 | .510 |
| .002312 | 17.80 | 1,880 | [871] | 1, 164 | .0798 | .0418 | .0926 | .177 |
| .002312 | 18.36 | 1, 890 | 871 | 1, 167 | .0800 | .0415 | .0950 | . 183 |
| II. | , | | , | • | | • |) | |